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NATURAL RESOURCES POLICIES AND PLANNING FOR DEVELOPING COUNTRIES

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NATURAL RESOURCES POLICIES AND PLANNING FOR DEVELOPING COUNTRIES

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1. Developing countries need to know a great deal about their natural resources of land, energy, water, and minerals, and about the industries, products, and services closely associated with them. They also need to make headway in translating that knowledge into programs of development. These two closely associated goals are important to developing countries because resource industries are dominant in their economic life, because improvement in the resource sectors usually is a prerequisite of escape from situations in which rapid population increase is accompanied by low productivity and income, and because raw material exports frequently have to be depended on for foreign exchange with which to purchase needed capital equipment. Furthermore, subsequent growth will be conditioned by the pattern of location of population and industry and by the development experiences established during the earlier phases of economic development when natural resource occurrences and characteristics are more influential.

2. The central purpose of this paper will be to characterize the role of resource policies and plans in the advancement of less developed countries. Resource policies, which are the more general principles and guidelines for development, and resource planning, which translates policies into concrete terms for land, water, energy and minerals, may be thought of as the connecting links between science and technology on the one side and higher economic and cultural attainments on the other. Of course, natural resources do not tell the full story of economic development; a skilled and capable labor force, capital plant and equipmen , an enterprising and well trained cadre of industrial managers, and impartial and decisive government administration are also vital. However, in a real sense, the whole economic pyramid rests upon raw materials and environmental resources and realization of their potentialities through the application of science and technology.

3. These considerations and others to be examined later have already been found to be of great importance in the developing countries, many of which have been making notable headway in analyzing their resource potentialities and translating them into effective policies and plans. In this paper we shall try to summarize the broad objectives of resource policy, to consider the conditions favorable for rapid and sustained progress in resources development, to indicate some principal elements of resource policy making and planning, and to discuss these elements in terms of specific situations in a selected less developed country. Finally, we shall point out several significant problems or obstacles to resource development that are common to many less developed countries.

Characteristics of Resources and Broad Objectives for Their Development

4. Natural resources differ from capital and other kinds of resources primarily in their relatively fixed geographic location and extent. Many raw materials can be extracted from the ground or harvested from the land and waters and shipped to distant points for consumption or further processing, but they all begin in a more or less fixed place and exist in finite amounts although neither the precise physical nor the economic extent may be known. There is the further characteristic that most resources are depletable in some sense. Mineral reserves in any particular location are depletable in an absolute sense; that is, they may be used up economically if not physically. The renewable resources of agricultural land, forests, grass lands, and fish populations may be exploited to the point where they can be reestablished only at prohibitively high cost, if at all. Another characteristic is that resources are the first links in the economic chain: resource materials enter technological processes early and then have applied to them varying degrees of fabrication and transportation on their way to becoming final consumer goods and services.

5. Every country needs to learn what resources it has, what their economic potentialities are, and how to translate mere existence into useable products and services. It must also determine where its comparative advantages lie and how these may change, since it will have insufficient capital, skilled manpower, or other means to develop all its resources in any given time period. This will mean for many countries a continuing concentration on food and fiber production for domestic consumption with less attention to production of mineral or agricultural raw materials for exports. For other countries the reverse will be true.

6. Each country will want to fit its resource development plans in with broader economic development plans. This frequently will call for investments and other activities to increase per-man and per-acre yields in agriculture along chosen lines, diminish over-all the number of agricultural workers, expand rapidly certain industries which at relatively low levels of capital intensity will make use of easily obtainable raw materials, and expand and diversify the energy base.

7. Economic activity in most of the less developed countries is heavily concentrated in the resource industries compared to more developed countries. In Brazil, for example, about 60 per cent of the labor force recently has been engaged in agriculture, forestry, fishing, mining, and quarrying; in India about 70 per cent; and in other less developed countries the percentage is even higher. In Italy, Japan, Mexico, and Spain the per cent of the labor force in resource industries has ranged in recent years from 40 to 60, while in the United States it is about 13 per cent. National income arising in the resource industries has also made up the larger part of total national income in nearly all the less developed countries, although the percentages are somewhat lower than those cited for the labor force, principally because of the lower level of labor productivity in agriculture than in industry.

8. Improvements in agriculture and the other basic resource industries in nearly every instance will be necessary if early stages of economic development are to be followed by diversified industrial development. All economic policies and plans therefore will be heavily oriented to resources. Resources, plus their transport and basic processing, become the core of development planning to provide food, water, building materials, heat, electric power, and many other items. First attention will usually be given to domestic sources for most of these, although a number of less developed countries have been able to export one or two particular raw materials in which they are especially well endowed as a means of obtaining yet other raw materials from other countries.

9. With these characteristics in mind the primary objective of resource policy may be stated. It is to promote the achievement of national objectives through development of land, water, energy, and minerals:

---at least cost;

---on a sustaining basis having in mind the conservation of existing supplies, the discovery of new sources, and the development of cheaper or more plentiful substitutes;

---with a high multiplying effect on further economic development;

---with significant contributions to better relations among nations for the advancement of all;

---so as to encourage a wide and equitable sharing of costs;

---so as to minimize or offset the difficulties of adjustment in particular regions and among particular groups.

10. Particular resource policies and plans may be tested against these objectives. Obviously these objectives overlap one another, are complex and difficult to determine in precise situations, and involve numerous contradictions. Policies and plans must be compromises among them. For example, least cost production in agriculture, if pursued relentlessly, might force large numbers of farmers out of agriculture and out of their particular farming regions before they could be retrained for other economic activities or before programs could be set in motion to aid them in adjusting to living in other communities. The requirements of national defense may also conflict with the least cost principle. Equitable sharing of costs is most difficult to define since it must be relative to individual values and broad social objectives which themselves are changing.

·Conditions for Progress in Resources Development

11. A number of conditions may be laid down for rapid and sustained progress in resource development. These will vary in relative importance from country to country, but will obtain to a significant degree in virtually all places. They include:

a. Increasing scientific and technical knowledge about resources, especially those on the more immediate horizon of development.

b. An improving professional education system for increasing the number of scientists, engineers, economists, industrial managers, administrators, planners, and others; and an improving general educational system in support of citizens' understanding of the part resources can play in economic advance.

c. Access to world sources of raw and processed materials and to world markets since self-sufficiency is either impossible or at least very costly for all countries.

d. Some containment, if possible, of the pressure of population at least in many of the less developed countries.

e. Reasonably stable government and competent administration.

f. Willingness to work hard and to save in the interest of more rapid development, to the extent of capacity.

g. Appropriate help from other more developed nations in finance, real capital, education, and technical aid on a carefully selected and fitted basis.

12. In many ways these conditions set out for progress in resource development are simply the specific application of the more general conditions of economic growth. Resource policies and plans must not only take them into account, but should aim at improvements leading to more effective utilization of new technology through increasing the skill of the labor force, fostering more efficient industrial management, providing lower cost electric power and heat, a better transportation system, and an increase of social capital in many forms.

Elements in the Resource Planning Process

13. Given the broad objectives for resource development and some knowledge as to the general conditions which will favor such development, how can the more specific and practical work of resource policy formulation and planning be improved? Two interrelated elements or aspects require consideration: framework and decision.

14. The framework element includes the relevant basic data (geologic, hydrologic, geographic, economic); social patterns and institutions within which resource development has to be worked out; systematic long-range estimates of demand and supply of resource materials as these are related to population estimates and foreseeable technologic changes; and the general goals of national and regional plans. The framework consists essentially of a layout of data, technologic possibilities, alternative supply sources, economic trends, institutional situations, and the like within which policy and planning decisions are made.

15. The decision element focuses on ways in which policy and planning decisions are actually made in public and private sectors of an economy. Decisions regarding broad policies for resources development, long-range development plans and budgets, particular resource projects, and administrative implementation are not clearly separated in practice; there is a continuum of decisions across a band from the more general to the more specific. Attention here will be given to the improvement of resource decisions by such means as benefit-cost, linear programming, and input-output analysis. These techniques can aid in appraising the merits of alternative resource development projects and systems of projects such as river basin development schemes and industrial complexes. Case studies of existing projects can also lead to improvements in future decisions. This element is concerned with the whole process by which decisions are reached; with the political, social, and aesthetic factors as well as the technologic and economic, and therefore with the points of view of various groups and with the conditions that have to be satisfied if their support, or at least acquiescence, in the decision is to be assured. It is not too much to say that the primary objective in resource planning is to establish an efficient decision-making process, important though particular investment and other decisions may be.

Framework

16. Resource policies and plans have to be visualized in various contexts: one of the most useful of these contexts is the long-range interrelated projection of demand and supply for resource products and services. Such a set of estimates may be made: first, by projecting the larger economic and demographic aggregates such as population, labor force, gross national product and its major components, and the like; second, deriving from these chiefly on the basis of historical relationships the demand for such resource products as meat, cotton, steel, construction lumber, fertilizer, and the like; and third, calculating the requirements for the basic resources of crop land, forest land, water, energy commodities, and metals from which products in the second stage may be produced. In this manner a bill of requirements for resource products and the basic resources themselves may be worked out within the constraints of anticipated increases in

population, work force, productivity, and national production. It will be helpful to work with ranges, probably quite wide ranges for years farther into the future, which will embrace a high, a low, and one or more intermediate estimates. Precisely where actual demand falls within the range will depend on how new technology is applied in industry, how consumer wants shift, the extent to which new sources at home or abroad open up, and the directions and effectiveness of policies designed to change the course of events which otherwise would follow.

17. On the supply side, the estimated requirements would have to be met within the overall constraints imposed by quantity and quality of known and potential natural resources as well as by the technical and economic capacity of the country or area in question to discover, extract, process, transport, and utilize these resources or those it can obtain from other countries. Technology and economics will form the bridge between estimates of demand and the manner in which they are satisfied. With skillful balancing of the variety of supply possibilities with estimated demands, with careful attention to the estimating of net returns of alternative courses of action and to economies of scale, development of the economy can proceed along efficient lines. One of the greatest difficulties in building this kind of framework will be the uncertainties which surround new technology and the rate of application of existing technology, and this is especially true for less developed countries.

18. Such a framework of projections is well suited for exposing incipient gaps between projected demand and likely supplies and for making estimates of possible changes in the relative prices of resource products.

19. This kind of exercise has been done for resources in the United States.[1/] The resource demand estimates, which are derived from projections of basic demographic and economic aggregates such as labor force and production, have been used as reference points in the analysis of supply possibilities and difficulties. For example, in the energy resources field consumption of all fuel and power, measured in a common unit, is estimated to increase about threefold by the year 2000 compared to 1960, while population is estimated to increase about 85 per cent and gross national product by more than four times. Within the total estimated increase in all energy, the shares of the several energy commodities and sources are expected to change. The most dramatic prospective shift will be in atomic energy; relative shifts among the conventional sources of coal, oil, and natural gas will be less marked than during the past century. Demand estimates (perhaps they should be called speculations) show atomic power to increase from virtually nothing in 1960 to 480 billion kilowatt hours in 1980 and 2,500 billion kwh in 2000, by which time well over half of the new electric power installations may be nuclear reactors. These are medium level estimates; a wide range of possibilities exists. The conventional fuel sources of coal, oil, and natural gas are expected to increase also but at much slower rates; by 2000 the demand for oil may increase by three times, natural gas by nearly that much, and coal by about 75 per cent.

20. Built into these projections of atomic power and other energy sources are numerous assumed changes in technology, some of them major. Failure to achieve considerable cost reductions in the production of atomic power will mean that conventional energy sources will have to be relied upon much more heavily, or other new sources such as oil shale, tar sands, low grade coal, and possibly unconventional sources will have to be drawn upon, if the energy sector is to grow in total as projected.

1/ Landsberg, Fishman, and Fisher, Resources in America's Future, to be published in the spring of 1963 by the Johns Hopkins Press for Resources for the Future, Inc.

21. Estimates of investment requirements for enlarged raw material production may be related to projections of demand for the materials themselves. Foreign trade enters into the picture in several ways: foreign demand has to be added to domestic demand for domestic raw materials, foreign supplies have to be subtracted from total supplies needed in order to get what will be required from domestic sources. A long range, interrelated, demand-supply framework such as has been described can help to set the stage of more realistic resource policies and plans, although it will not specify what the policies and plans have to be. The projections bring major problems into focus and narrow the range of useful courses of action. The working through of these projections requires at least a minimum knowledge of aggregative demographic and economic trends, of technical relationships between resource inputs and outputs of resource products and services, as well as scientific and technical knowledge about the basic resources themselves. The greater the amount and the higher the quality of such information, the more realistic and useful will be the framework of projections. Wide ranges in the demand estimates will be the better part of wisdom; policies based upon such projections should also be flexible so that they may be altered in the light of unfolding events.

22. Another useful instrument for framework planning is comprehended by the term systems analysis, by means of which a resource complex is stripped of non-essential elements and placed within a model that expresses the significant interrelationships. The principal variables may then be manipulated in such ways that the output or performance of the system can be described quantitatively and tested against performance criteria. Typically, high speed computers will be necessary to do this. Systems analysis in this sense has been experimented with, both in theory and in simulated practical applications in a number of resource situations including river basin development schemes. 2/ This kind of engineering-economic analysis can throw much light on the efficiency of alternative development programs and, placed in relevant political and administrative formats, can aid greatly in reaching wise decisions. Still other kinds of framework exist or can be constructed,-for example, legal, administrative, and institutional, which can aid in placing resource planning in better perspective, but these are not elaborated here.

Decision

23. The processes of policy-making and planning are carried on within whatever frameworks (demand-supply systems, legal, institutional, and others) may be constructed. How may these processes be made more effective so that one project or phase of the actual plan that is undertaken may lead easily and logically into the next? Here we are concerned with the strategy and sequence, with the smooth meshing of the several parts, in such a way that initial impulses toward development can exert a multiple effect on the economy and the whole plan can move toward fulfillment with a minimum of delays and detours. Especially we are concerned with the way in which policy and planning decisions are made and with their quality and effectiveness. The improvement of decisions is to be achieved partly by better facts and analysis, and partly by improving the way in which facts and analysis are used. On issues of major significance decisions are governmental decisions in the public sector and top management decisions in the private sector. Over all are the broad political decisions as to national goals and policies; underlying all are the preferences, motivations, and actions of individuals.

2/ Maass, Hufschmidt, Forman, Thomas, Marglin, and Fair, Design of Water-Systems, (Harvard University Press, Cambridge, 1962).

24. Several kinds of analysis may be useful in guiding those who make decisions about policies and plans. One kind which has been used in the United States, especially in the water resources field, is called benefit-cost analysis. Essentially this comprises the identification of alternative projects for achieving roughly the same purposes, an estimate of the costs which will be incurred over the life of the project, and a comparison of the estimated benefits and costs for each of the alternative projects. Many difficulties arise in this kind of analysis, some of which have to be settled arbitrarily. What shall be the assumed length of life of the project? What would be the appropriate rate for discounting the flow of future benefits and future costs? Should the rate be related to some private market rate of interest or should it be a public or social rate? What course of prices and costs should be assumed for the future? Perhaps most vexing of all is the question of what range of particular benefits and costs should be included in the analysis at all; especially, should those of a more intangible, remote, and social nature be included -- and if so in what way?

25. Much attention has been given to benefit cost analysis in the United States and indeed for most water development projects federal law requires that such analysis be undertaken and the result presented to the Congress along with other information about the proposed project. Uniform procedures have been established and form the basis for field investigation of benefits and costs. Questions like those raised here have been given a good deal of critical attention in recent years, and as a result benefit-cost estimating techniques have been refined, somewhat more sharply delimited, and in general made more understandable and useful. Benefit-cost estimating for alternative resource development projects may also be helpful in less developed countries although lack of a competitive price system including a money market, the large size of many projects in relation to the resources available for accomplishing them, and the necessary emphasis on social purposes make the technique clumsy and ineffective in many instances unless it is severely limited to appraising the merits of specific alternative projects, for example, dams of different heights or in nearby locations.

26. Also of use in less developed countries may be the input-output kind of analysis in which the sectors of the economy are viewed in terms of the relationship between the input of resources and other items on the one side and the output of final products and services on the other side. Data can be gathered and organized in such a way that the coefficients expressing these relationships may be calculated and a matrix established. It then becomes possible to assume a mix of final outputs and calculate the inputs that will be required to give the desired results. Such a schema can be used to estimate the effects of alternative paths of national development; regional input-output matrixes would permit the testing of larger scale resource projects.

27. Several difficulties arise at once: a considerable amount of technical and economic data are needed, although to some extent the input-output technique can be used with a minimum of data; the technical coefficients relating inputs and outputs may change especially in countries growing rapidly and shifting toward more industry and more mechanized farming. This technique, however, does enable broad appraisals and comparisons of different sets of resource development projects to be made.

28. A more narrow and focused variant of this approach is the linear programming model in which outputs of particular items, for example, are regarded as a function of a number of independent and variable factors. With the relevant data inserted, such systems of equations may be manipulated in various ways and made to yield solutions which are optimal in terms of selected criteria. Other analytical methods useful in improving decisions include game and queueing

theories, simulation, minimax and related techniques.

29. In addition to these more technical means for improving policy and planning decisions, we must call attention to the importance of the way in which data and analysis are handled at the points of decision. Essentially this is a matter of organizing and bringing forward various kinds of evidence bearing on the policy or the plan in such a way that a comprehensive and balanced picture is made available to the decision makers at the time the decision has to be made. The evidence obviously will include engineering and economic analysis, and it should also include broad social, political, and aesthetic argument. The broader the policy or plan under consideration, the more general will be the evidence and argument. The more narrow and focused the policy or plan, the more specific and perhaps quantitative it can be. Finally there can be no substitute for well-trained, politically and socially sensitive persons in the decision making positions -- persons who will be able to bring together the various plans and analyses with a keen appreciation of the conditions which will have to be met if necessary support is to be obtained. Policy making and plan making at the higher and more general levels tend to be political acts concerned with the public sector or the regulation of the private sector. In national planning as carried out in most of the less developed countries, the scope and general role of the private sectors are also marked out in the plan so that the larger private resource decisions are embraced by and consistent with the public decisions.

Resources Planning and National Development: An Example from Pakistan

30. Resource policy and planning have to be viewed in the full context of national development if they are to serve that cause effectively. A development strategy must pull together the natural resource potentialities with the available manpower and capital resources in a dynamic program for resource and national development. Particular attention should be given to shortages and obstacles of a general economic nature (e.g. insufficient savings, foreign exchange, or trained manpower) and to those related more closely to natural resources (e.g. low agricultural productivity, high-cost energy materials for heat and power, or undeveloped mineral resources) Insufficient or poor quality data for better resource planning frequently will be the first obstacle.

31. The interrelationships involved in resource planning for national development and the need for a development strategy may be illustrated in the case of agriculture in many of the less developed countries where yields are depressingly low and have not risen very much in recent years. Usually more than one factor of productivity limits yields: lack of water at the right place and time, sometimes too much water, not enough fertilizer, farms too small in size, and others. An integrated and concentrated attack on these factors is needed and will involve communication with farm operators, social and economic analysis as well as much applied agricultural research, and better administration of agricultural programs. Achievement of initial momentum is essential but not at the cost of foreclosing future possibilities. Above all, a strong economic motivation on the part of farm operators and workers must be created. Program and expenditure choices usually exist -- for example, development of surface versus underground water, or new agricultural land versus more intensive cultivation of land presently farmed. In laying the basis for wise choices, interrelated social, economic, and engineering analysis, frequently using modern techniques such as those mentioned earlier, can be highly effective.

32. Many of the principles of resource development and the kinds of analysis useful in resource planning are revealingly illustrated by the problem of

agriculture in West Pakistan. 1/ The flat, fertile Indus Plain, most of which lies in West Pakistan, contains the largest single irrigated area on earth. With its sandy and silty soils, year-round growing season, large surface flow of water, highly developed system of irrigation canals, huge underground reservoir of fresh water, underground pools of natural gas, and a wide range of crops that can be grown, the Plain is one of the chief physical assets of the world's fifth most populous country. Yet, despite its potentialities, incomes from agriculture remain very low, and there is a deficit of both calories and animal proteins in the diet of the people. Population is increasing more rapidly than food production.

33. One of the problems of agriculture in West Pakistan is waterlogging and salt accumulation in the soil, caused by poor drainage in the vast, nearly flat Plain. Agricultural production is also held down by a shortage of irrigation water. Because of canal seepage and other losses, only about half the water diverted from the rivers is available to crops. Much of the planted area receives too little water to prevent salt accumulation. Chemical fertilizers, protective measures against plant diseases and pests, and high-yielding plant varieties are very little used. Other handicaps are the system of land holding and primitive methods of cultivation.

34. In establishing the framework for agricultural development, the need to raise present per capita food production by 30 to 40 per cent and the range of probable population growth in West Pakistan of between 50 and 100 per cent over the next 25 years must be considered. Increases in sugar and cotton production will be required to meet the demand of both East and West Pakistan. As living standards rise, the relative demand for fruits, vegetables, and livestock products will grow. Additional increases in agricultural production will have to be based on export markets or industrial use of farm products.

35. Maps of the mechanical composition, salt content, and cation-exchange characteristics of the soils are needed, not only as a basis for determining cropping patterns, but also for planning capital expenditures for development. For example, the high salt and sodium contents of the soils in much of the Indus Delta region raise serious question concerning the economic potentials of these lands. Considerable further investigation is needed to determine the areas of fresh and saline underground water, and the chemical composition of the salt water. Much of the latter has a sufficiently low salt content so that it can be used for irrigation when diluted with fresh canal waters.

36. A plan for greatly increasing agricultural production is being devised by means of which technological possibilities can be brought into effective relationship with economic feasibilities and human capabilities. In the northern two-thirds of the Plain, the supply of irrigation water for actual consumptive use by plants can be doubled, in part by river regulation through surface storage, but chiefly by constructing a network of carefully-spaced tubewells to recover canal seepage and allow controlled mining of the underground water. The tubewells will also make it possible to leach the accumulated salts out of the soil and ultimately to eliminate waterlogging.

37. Yields per acre can be increased by providing more irrigation water, and water at the right time, by the use of fertilizer, by controlling plant diseases and pests, by the development and use of improved seed and crop varieties, and by the introduction of better cultivation practices. Each of these five production factors may increase yields 20 per cent when applied singly, but in combination they could

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1/ The following discussion is based on the work of the U.S. White House - Interior Panel on Waterlogging and Salinity in West Pakistan, undertaken in 1962.

give increases of 200 to 300 per cent. In order to integrate all the factors of production, it is necessary to concentrate their application in project areas of manageable size. Analysis of the hydrologic processes involved, and of the economics of fertilizer production, indicate that the project areas should contain about a million acres. If adequate capital and technical manpower can be made available, it should be possible to initiate development of a new million-acre project each year.

38. Linear programming analysis shows that the principal benefit from the tubewell water will come from the maximum possible expansion of the planted areas during the summer season in the most profitable crops.

39. Electric power for pumping water can be obtained either by hydroelectric development in the mountains and foothills of the north, or by thermal plants using natural gas. West Pakistan is fortunate in having fairly large reserves of natural gas, which can be used also as a source of nitrogenous fertilizer. With electricity, phosphate fertilizers can be made from imported raw material.

40. To attain momentum in increasing production, an optimal sequence of capital investment is essential. First expenditures should be for development of underground water and drainage, fertilizer plants, pest control facilities, training and organization of technicians, administrators, and field workers to assist the farmers, development of better plant varieties, and needed investigations. Later, roads and transportation facilities must be provided to haul a greatly increased volume of agricultural products to the cities and towns. Processing mills and textile factories will have to be built to utilize these products profitably. Still later, a farm machinery industry will be needed, and factories to produce consumer goods for the farmers will ultimately be required. Only a few conveyance channels to carry off salty waters in order to maintain a salt balance will be needed at first, but many of these relatively expensive structures must be built within about 20 years of the initial development.

41. In the northern two-thirds of the Plain, an initial capital investment of about Rs 260 to 285 an acre is needed in order to allow integrated use of the primary factors of production. Ultimate expenditure may be several times this amount. After full development, the maximum net increase of crop value in the northern area from additional water, fertilizer, plant protection, and presently existing better plant varieties, could be Rs 3.6 billion, equal to twice the average gross production during the last decade, excluding livestock.

42. All aspects of the program rest on vigorous education and agricultural extension efforts to guide the farmers in carrying out their part of the task, ample credit to make the farmers' participation possible, and efficient marketing and distribution facilities. Massive and determined effort, and continuing experimentation will be necessary to transmit new technical skills to very large numbers of desperately poor and illiterate farmers, and to create economic conditions in which they will be motivated to help themselves.

Some Common Problems of Resource Development

43. A few common problems of resource development in less developed countries may be listed here. Some are theoretical; some are practical. Research and experimentation offer the best avenues for dealing with them. The kinds of analysis suggested in this paper seem promising. These problems include:

---Improving the amount and quality of resource data, both scientific and

economic, and further testing of analytical methods so as to make the data more useful in planning.

---Determining a strategy of resource development in national economic growth. What are the main elements of such a strategy? What variables are critical for forward motion and how may they be manipulated? What sequence and combinations of industrial investment, workers' training, agricultural improvement, and occupational and regional shifts are called for in each country for the resource sectors?

---Interrelating more closely the food and raw material shortages in some countries with surpluses of production or capacity in others.

---Devising workable international arrangements for financing resource development, for market and price stabilization, and for technical aid in resource planning.

---Finding an effective division between public and private sectors with appropriate interrelating of the two. The line of division will, of course, vary from country to country according to its particular history and present situation.

---Appropriate safeguarding of the productiveness of basic resources, such as soil and water, and of the quality of the natural environment.

---Adjusting to the declining relative importance of agriculture and some other resource industries in national economies. This will involve a balancing of programs for raising agricultural efficiency (better farming practices, improved processing and marketing of crops, more machinery and power, better health and education, more credit) with programs of industrialization, principally in urban areas.

---Adopting cost-reducing technology in resource activities as rapidly as possible.

44. Within each country, and perhaps within each sub-national development region, an organizational means for resource development planning, at least for the coordination of such planning, will be beneficial. Some countries have such arrangements; others do not. Typically this will mean drawing together representatives from a number of departments or agencies of the government spanning the various natural resources of land and agriculture, forestry, fisheries, water and power, energy, minerals, and the like so that comprehensive and multiple purpose policies and plans may be worked out. In many countries, this may be done within or in conjunction with national and regional planning bodies. To begin with, data gathering and research in the resources field should be coordinated and given central attention.

45. Since common problems of resource policy-making, planning, and development are to be found in one form or another in virtually all less developed countries, and since the more developed countries will also have to take some part in solving them, frequently through the use of analytical techniques as described in this paper, there would appear to be much to be gained from a more concerted attack on them than has thus far been made. We suggest, therefore, that consideration be given to the establishment of a World Resources Development Institute with the following purposes:

a. To undertake, and stimulate others to undertake, scientific, technologic, statistical, and economic research on natural resources, especially as such research bears on policy and planning.

b. To foster exchange of information, and perhaps to establish a central library of knowledge.

c. To encourage the education and training of resource specialists through seminars, fellowships, exchanges of personnel, and the like, working in relation with existing universities and public and private institutes.

d. To build an international panel of resource specialists for technical aid in water, land, energy, and minerals, with emphasis on the planning of developments in these fields.

e. To cooperate with various groups concerned with resources, including other international agencies, national and sub-national organizations, and appropriate private groups.

46. Direction of such an institute could be by an international board of world leaders in the resources field, of scientists, engineers, planners, economists, administrators, and educators. Possibly the national academies of science or some similarly respected bodies could act as sponsors. Financing might come from participating countries or organizations, foundation grants, or from the United Nations or its specialized agencies concerned with resources. The institute could be a part of United Nations, or it could be outside UN but cooperating with UN and certain of its specialized agencies.

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